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| FORM PTO-1390 (REV 11-98) | | U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE | ATTORNEYS DOCKET NUMBER LLBR:0003/YOD |
| TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371 | | | U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/806062 |
| INTERNATIONAL APPLICATION NO. PCT/FR00/02098 | INTERNATIONAL FILING DATE 21 July 2000 | PRIORITY DATE CLAIMED 23 July 1999 | |
| TITLE OF INVENTION ELECTRONIC ASSEMBLY COMPRISING A SOLE PLATE FORMING A HEAT SINK | | | |
| APPLICANT(S) FOR DO/EO/US Gérard-Marie Martin, Laurence Lenne | | | |
| Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information: | | | |
| <p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input type="checkbox"/> Amendments to the claims of the International Application</p> <p>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input type="checkbox"/> have been transmitted by the International Bureau</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (unsigned)</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5))</p> <p>Items 11. To 16. Below concern document(s) or information included:</p> <p>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4)</p> <p>20. <input type="checkbox"/> Other items or information. Other items or information</p> | | | |

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JC10 Rec'd PCT/PTO 23 MAR 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Gérard-Marie Martin et al.

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Group Art Unit: Unassigned

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International Application No.: PCT/FR00/02098

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International Filing Date: July 21, 2000

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Examiner: Unassigned

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Serial No.: Unassigned

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Filed: Herewith

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For: ELECTRONIC ASSEMBLY
COMPRISING A SOLE PLATE
FORMING A HEAT SINK

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Atty. Docket: LLBR:0003/YOD
(BR 3085)

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Assistant Commissioner
For Patents
Washington, D.C. 20231

| "EXPRESS MAIL" MAILING LABEL | |
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| NUMBER: | EL652335329US |
| DATE OF DEPOSIT: | March 23, 2001 |
| <p>Pursuant to 37 C.F.R. § 1.10, I hereby certify that I am personally depositing this paper or fee with the U.S. Postal Service, "Express Mail Post Office to Addressee" service on the date indicated above in a sealed envelope (a) having the above-numbered Express Mail label and sufficient postage affixed, and (b) addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.</p> | |
| March 23, 2001 | <i>Lynda Howell</i> |
| Date | Lynda Howell |

Dear Sir:

PRELIMINARY AMENDMENT

Prior to calculation of the fees for and examination of the above-referenced National Phase filing, please amend the subject application as follows:

IN THE CLAIMS

Please cancel claims 1-8 without prejudice.

Please add the following new claims:

9. (New) An assembly supported on a base forming a radiator or capable of being mounted on such a base, comprising a printed circuit card which has in its thickness a plurality of

holes intended to transfer heat between one face of the said printed circuit card, which supports one or more electronic components each enclosed by a box, and the base forming a radiator, having a plurality of pads which are made of a thermally conductive material and pass through the printed circuit card over substantially its whole thickness while being housed by the holes therein, in order to transfer heat between one face of the printed circuit card, which supports one or more components, and the base, the pads are integral with a plate, referred to as the sole plate, which supports them, wherein the sole plate is interposed between the printed circuit card and the base.

10. (New) The assembly according to claim 9, wherein the sole plate is made of the same material as the bottom of the box of components or of a material with similar coefficient of expansion and/or electrical conductivity.

11. (New) The assembly according to claim 9, comprising a ductile thermal joint through which it is in contact with the base.

12. (New) The assembly according to claim 10, wherein pads are directly supported by the box of electronic components and are in contact with the base through a ductile joint.

13. (New) The assembly according to claim 9, wherein the sole plate has complementary means capable of mechanically holding it to the card.

14. (New) The assembly according to claim 13, wherein the complementary holding means are spikes which are supported by the sole plate and are force-fitted into holes in the printed circuit card.

15. (New) The assembly according to claim 9, wherein the sole plate and the pads are soldered to the printed circuit card in order to spread the thermal dissipation.

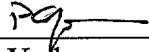
16. (New) The assembly according to claim 9, wherein the sole plate and the pads are soldered to the printed circuit card in order to spread the thermal dissipation and wherein the sole plate has through-holes for discharging the residual air possibly trapped in the solder.

REMARKS

If the Examiner believes that a telephonic interview will help speed this application toward issuance, Applicant invites the Examiner to contact the undersigned at (281) 970-4545.

Respectfully submitted,

Date: March 23, 2000



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PCT/FR00/02098

ELECTRONIC ASSEMBLY COMPRISING A SOLE PLATE FORMING A
HEAT SINK

The present invention relates to an assembly of the type comprising a printed circuit card and a sole plate forming a heat sink, which are arranged on a base forming a radiator.

In an assembly of this type, the printed circuit card is conventionally a double-sided card which has metallized holes TM, as illustrated in Figure 1.

These metallized holes TM constitute what are called "thermal vias" which, in addition to the electrical interconnection between the two sides of the substrate, allow heat to be transferred between the base and the heat-dissipating components with which the card is equipped.

However, the amount of heat which these holes can transfer is small. The reason for this is that, even though the thermal conductivity of copper is about 1000 times higher than that of the epoxy materials used to produce the substrates of the printed circuit cards, the thickness of the copper layers deposited on the walls of the holes which pass through the substrates is very small (of the order of 30 μm) so that little heat is transferred.

In an assembly of one or more components on a printed circuit card having thermal vias, the document US-A-5 646 826 proposes to increase the heat-transfer capacity of these holes by injecting into them a material whose thermal dissipation properties are superior to those of the printed circuit card forming the substrate. Injection solutions of this type are generally expensive and require the use of specific and elaborate tools.

In an assembly of one or more components on a printed circuit card, the document DE-A-196 01 649 proposes to replace some of the printed circuit card by a bulk metal part which is more conductive than the printed circuit card. Using a bulk metal part causes

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problems with the flatness of the assembly and subjects the printed circuit card to significant lateral stresses.

5 The solutions employed in the prior art have a number of drawbacks which need to be resolved.

10 It is therefore an object of the invention to provide an assembly with a heat sink which allows better heat transfer between the metal base of the boxes of the power components supported by the printed circuit card and the base, by means of a heat sink which permits better cooling or better thermal dissipation for the electronic card.

15 To that end, the invention proposes an assembly supported on a base forming a radiator or capable of being mounted on such a base, comprising a printed circuit card which has in its thickness a plurality of holes intended to transfer heat between one face of the said printed circuit card, which supports one or more electronic components each enclosed by a box, and the
20 base forming a radiator, having a plurality of pads which are made of a thermally conductive material and pass through the printed circuit card over substantially its whole thickness while being housed by the holes therein, in order to transfer heat between
25 one face of the printed circuit card, which supports one or more components, and the base, the pads (4a) are integral with a plate (4), referred to as the sole plate, which supports them, characterized in that the sole plate (4) is interposed between the printed
30 circuit card (1) and the base.

The invention is advantageously supplemented by the various characteristics below, taken individually or in any of their feasible combinations:

- 35 - the sole plate is made of the same material as the bottom of the component box or of a material with equivalent coefficient of expansion and/or thermal conductivity;
- the assembly has a ductile thermal joint through which it is in contact with the base;

- pads are directly supported by the box of electronic components and are in contact with the base through a ductile thermal joint;
- the sole plate has complementary means capable of mechanically holding it to the card;
- the complementary holding means are spikes which are supported by the sole plate;
- the sole plate (4) and the pads (4a) are soldered to the card in order to spread the thermal dissipation;
- the sole plate has through-holes for discharging the residual air possibly trapped in the solder.

Other characteristics and advantages of the invention will become more apparent from the description below, which is purely illustrative and does not imply any limitation, and should be read with reference to the appended drawings, in which:

- Figure 1, which has already been analysed, illustrates a printed circuit card structure having holes (metallized or non-metallized) according to an embodiment which is known from the prior art;

- Figure 2 is a diagrammatic sectional representation of an assembly according to a possible embodiment of the invention;

- Figure 3 is a diagrammatic sectional representation of an assembly according to a possible embodiment of the invention, incorporating holding means between the sole plate and the printed circuit card;

- Figures 4a and 4b are diagrammatic sectional representations of an assembly according to another possible embodiment of the invention.

The assembly illustrated in Figure 2 comprises a printed circuit card 1 equipped with one or more boxes of surface-mount electronic components 2. These component boxes have a metal base at their bottom adjacent to the printed circuit card. The assembly also comprises a part 3, namely a base forming a radiator which is intended to dissipate the heat generated by the card 1 and the component or components 2.

A sole plate 4 made of a highly conductive material is interposed between the card 1 and the base forming the radiator.

5 This sole plate 4 has a plurality of pads 4a which project from its face directly adjacent to the card 1 and pass through the said card 1 over substantially its whole thickness via through-orifices 5 therein.

10 Here, and throughout the present text, the term "pads" is intended to mean elements which are independent of the card 1 and which, in particular, are distinct from any metallized layer which this card 1 may have, in particular in its through-orifices 5.

15 The sole plate 4 is preferably made of the same material as the base of the bottom of the box of a component 2, or of a material whose coefficient of thermal expansion and/or thermal conductivity are similar to those of the base of the bottom of the box. For instance, the sole plate is preferably made of
20 copper.

In order to promote the contact between the sole plate 4 and the base 3, a ductile thermal joint 6 is inserted between these two parts. This joint enhances the thermal dissipation.

25 The box or boxes of SMD components 2 are, for example, welded to the card 1 and the ends of the pads 4a by soldering. The sole plate 4 may also be welded to the printed circuit card 1 by soldering.

30 This soldering operation may be carried out directly in a single step but, for reasons of handling the parts during production of the assembly, it may be desirable to carry out the soldering in two steps. For instance, the sole plate 4 is firstly welded to the printed circuit card 1 by soldering, then the box or
35 boxes of components 2 are welded to the printed circuit card 1 by soldering.

The sole plate 4 and the pads 4a are welded to the printed circuit card in order to obtain greater thermal dissipation. To explain: increasing the contact

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by means of the solder optimizes the transfer of energy to the base 3 and spreads the thermal dissipation in the best way. Nevertheless, an adhesive bonding process could alternatively be used to produce these assemblies.

The base 3 forming the radiator is, for example, an aluminium part covered with a layer of electrical insulator.

With such a structure, the quantity of material which conducts heat through the substrate of the card 1 is greatly increased. The heat transfer is therefore enhanced very significantly between the upper face of the card 1 and the base 3 forming the radiator.

Of course, the pads 4a are preferably solid elements so as to ensure the greatest possible thermal transfer.

This solution advantageously allows the sole plate 4 to be regarded as an entirely separate "component" which is fitted in place when the assembly according to the invention is being produced.

The diameter of the metallized or non-metallized holes TM made in the printed circuit card 1 is between 0.4 and 1 mm on average. It is then possible, knowing the size of the power component boxes, approximately to estimate the number of pads present under each component box. The number of pads present under each component box varies between 10 and 20 depending on the size of the component box. This is a large number of pads, which in fact allows a significant improvement to the thermal dissipation of the heat produced by the power component.

Figure 3 presents an assembly according to the invention provided with an example of complementary means for holding the sole plate 4 on the printed circuit card 1.

In addition to the pads 4a, the sole plate 4 comprises means which hold it mechanically with respect to the printed circuit card 1. These complementary means are, for example, elastic locking means (clips)

or force-fit spikes.

Figure 3 presents a sole plate 4 comprising spikes 4b of conical general shape, in order to permit force-fitting of the spikes 4b into holes made in the printed circuit card 1, so as to hold the printed circuit card 1 with respect to the sole plate 4 regardless of the way in which the assembly is handled.

The sole plate 4 also has through-holes 4c at certain positions, to discharge the residual air which might remain trapped in the solder under the power component.

The card 1, the sole plate 4 and the base 3 forming the radiator are then assembled by cold pressing or crimping, or by any other technique (screwing, pressure spring) which mechanically secures the assembly. This assembly might advantageously be produced on a structured base which has two levels, one being set back further to receive the sole plate 4, and the other being less deep and having a thickness equal to that of the sole plate 4 on which the printed circuit rests, and onto which level the assembly is crimped.

The assembly according to the invention makes it possible to accommodate the expansion conditions of the various elements relative to one another, and ensures that the assembly is flat by virtue of the presence of a reference surface on the sole plate (4).

As a variant, one or more thermal pads may be supported directly by the SMD components 2, instead of being supported by an independent metal sole plate.

This is what Figures 4a and 4b illustrate.

The printed circuit card 1 is mounted on the base 3 by means of a thermal ductile joint 6 and supports the components 2 on its face remote from the joint 6 and the base 3.

In this configuration, the ductile thermal joint 6 is interposed between the card 1 and the base 3, one or more pads supported by the components 2 being in contact with the base 3 through the said thermal

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joint 6.

It is further possible to improve the thermal dissipation by combining the use of a box of components 2 having pads and a sole plate 4 having pads 4a, as
5 Figure 4b shows.

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PATENT CLAIMS

1. Assembly supported on a base forming a radiator or capable of being mounted on such a base, comprising
5 a printed circuit card (1) which has in its thickness a plurality of holes (5) intended to transfer heat between one face of the said printed circuit card (1), which supports one or more electronic components (2) each enclosed by a box, and the base (3) forming a
10 radiator, having a plurality of pads (4a) which are made of a thermally conductive material and pass through the printed circuit card (1) over substantially its whole thickness while being housed by the holes (5) therein, in order to transfer heat between one face of
15 the printed circuit card (1), which supports one or more components (2), and the base, the pads (4a) are integral with a plate (4), referred to as the sole plate, which supports them, characterized in that the sole plate (4) is interposed between the printed
20 circuit card (1) and the base.
2. Assembly according to Claim 1, characterized in that the sole plate (4) is made of the same material as the bottom of the box of components (2) or of a material with similar coefficient of expansion and/or
25 electrical conductivity.
3. Assembly according to Claim 1, characterized in that it has a ductile thermal joint (6) through which it is in contact with the base (3).
4. Assembly according to Claim 2, characterized
30 in that pads are directly supported by the box of electronic components (2) and are in contact with the base (3) through a ductile joint (6).
5. Assembly according to Claim 1, characterized in that the sole plate (4) has complementary means
35 capable of mechanically holding it to the card (1).
6. Assembly according to Claim 5, characterized in that the complementary holding means are spikes (4b) which are supported by the sole plate (4) and are

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force-fitted into holes in the printed circuit card (1).

7. Assembly according to Claim 1, characterized in that the sole plate (4) and the pads (4a) are soldered to the printed circuit card (1) in order to spread the thermal dissipation.

8. Assembly according to Claims 1 and 7 taken in combination, characterized in that the sole plate (4) has through-holes (4c) for discharging the residual air possibly trapped in the solder.

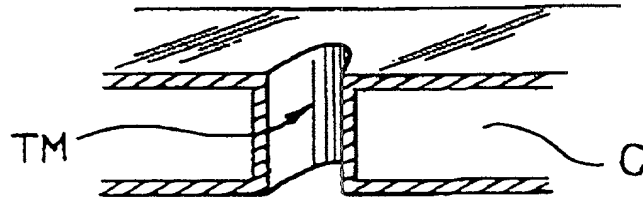


FIG. 1

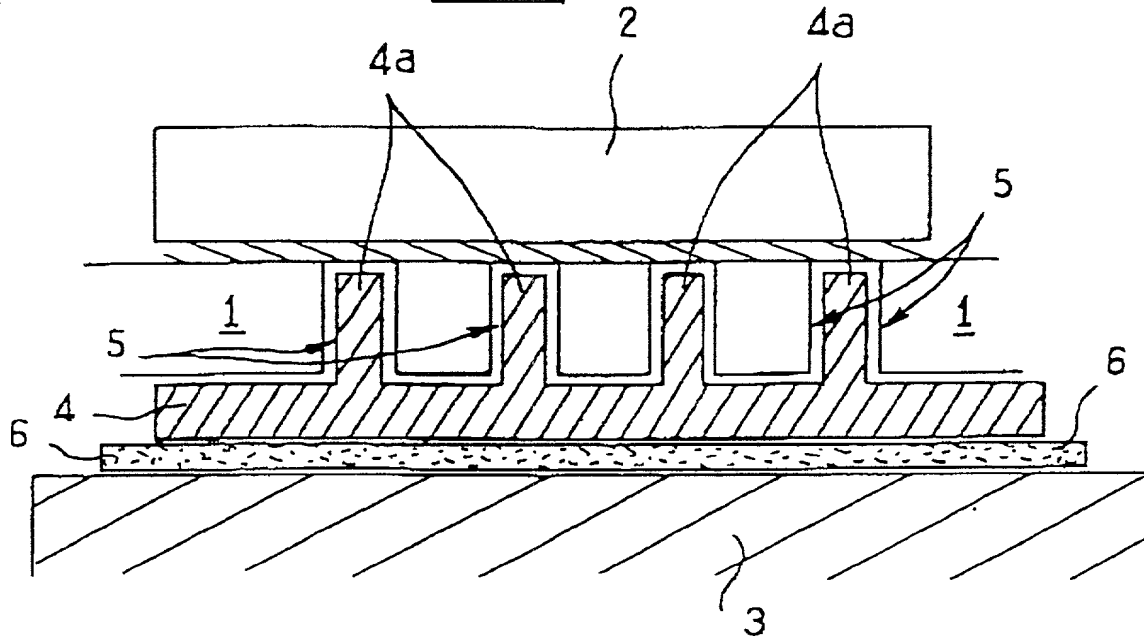


FIG. 2

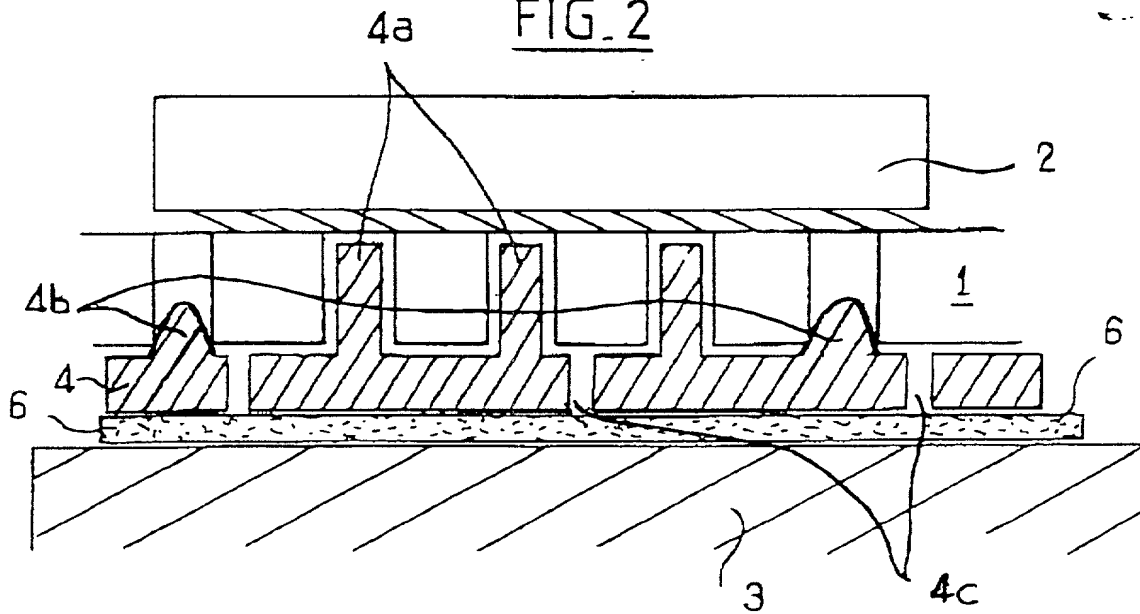
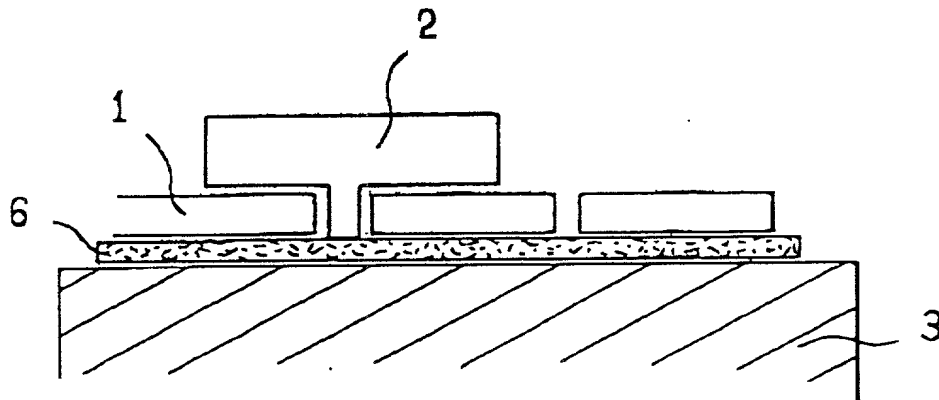
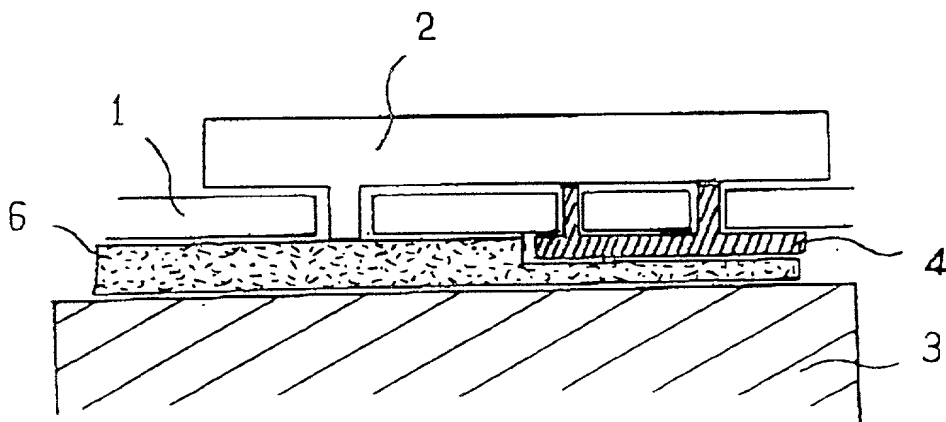


FIG. 3

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FIG. 4aFIG. 4b



PATENT
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COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **ELECTRONIC ASSEMBLY COMPRISING A SOLE PLATE FORMING A HEAT SINK**, the specification of which was filed on March 23, 2001 ✓

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, U.S.C. §119 of any foreign application for patent or inventor's certificate listed below, and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

| COUNTRY | APPLICATION NUMBER | DATE OF FILING (day, month, year) | PRIORITY CLAIMED UNDER 37 U.S.C. 119 |
|----------|--------------------|--------------------------------------|---|
| France ✓ | PCT/FR00/02098 ✓ | 07/21/00 ✓ | YES |

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

| APPLICATION SER. NO. | APPLICATION SER. NO. | FILING DATE | STATUS (patented, pending, abandoned) |
|----------------------|----------------------|-------------|---------------------------------------|
| | | | |

5- I hereby appoint Patrick S. Yoder (Reg. No. 37,479), Michael G. Fletcher (Reg. No. 32,777), Robert A. Van Someren, (Reg. No. 36,038), Diana M. Sangalli (Reg. No. 40,798), and Ralph A. Graham (Reg. No. 47,607) of Fletcher, Yoder & Van Someren, 7915 FM 1980 West, Suite 330, Houston, Texas 77070, jointly, and each of them severally, my attorneys, with full power of substitution, delegation and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent and to transact all business in the Patent and Trademark Office connected therewith.

I hereby direct that all correspondence and telephone calls in connection with this application be addressed to Patrick S. Yoder, 7915 FM 1980 West, Suite 330, Houston, Texas, 77070, (281) 970-4545.

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